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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/698,964	10/31/2003	Kenneth O. McElrath	3006.001800/KDG	8810

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EXAMINER	
ONEILL, KARIE AMBER	
ART UNIT	**PAPER NUMBER**
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01/29/2009	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/698,964	MCELRATH ET AL.	
	Examiner	Art Unit	
	Karie O'Neill	1795	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *06 November 2008*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,4,6,8-17 and 63* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,4,6,8-17 and 63* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *31 October 2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

1. The Applicant's amendment filed on November 6, 2008, was received. None of the claims have been amended. Claims 2-3, 5, 7 and 18-62 have been cancelled. Therefore, Claims 1, 4, 6, 8-17 and 63 are pending in this office action.

2. The text of those sections of Title 35, U.S.C. code not included in this action can be found in the prior Office Action issued on July 8, 2008.

Claim Rejections - 35 USC § 103

3. The rejection of Claims 1, 6, 8-17 and 63 under 35 U.S.C. 103(a) as being unpatentable over Smalley et al. (US 2005/0249656 A1) in view of Hampden-Smith et al. (US 2003/0198849 A1), are maintained. The rejection is repeated below for convenience.

With regard to Claims 1, 6 and 63, Smalley et al. discloses forming a patterned array of single-walled carbon nanotubes (SWNT) wherein the SWNT are derivatized with a functional group (paragraph 0011) and may be used in conjunction with carbon black (paragraph 0059). The single walled carbon nanotubes have a diameter ranging from about 0.6nm up to 3nm, 5nm, 10nm, 30nm, 60nm or 100nm (paragraph 0064). The SWNT and carbon black form a planar mat or "bucky paper" having a thickness of about 100 microns (paragraph 0099). Smalley et al. discloses a catalyst metal comprised of platinum, in contact with the mat of carbon nanotubes. Smalley et al. also discloses wherein the catalyst metal further comprises one or more of the Group VI or

VIII transition metals, specifically ruthenium, chromium, molybdenum, tungsten, iron, cobalt, nickel, rhodium, palladium, osmium and iridium (paragraphs 0161-0162). The SWNT exhibit a high level of conductivity, fewer defects than multi-walled carbon nanotubes and are very strong (paragraph 0058). Smalley et al. does not disclose the use of the SWNT to form a fuel cell electrode for use in a proton exchange membrane fuel cell or a direct methanol fuel cell. Smalley et al. also does not disclose wherein the catalyst metal is present in an amount less than 400 µg/cm2 of the planar area of the mat of carbon nanotubes and carbon black and wherein the electrode provides greater than 1 mA/cm^2 per µg Pt/cm^2 of the planar area of the mat of carbon nanotubes and carbon black.

Hampden-Smith et al. discloses electrocatalyst powders for use as electrodes in fuel cells (paragraph 0027). Hampden-Smith et al. discloses the use of homo- and hetero-fullerene and carbon nanotube based materials as active components in the reduction of oxygen (paragraph 109). Hampden-Smith et al. also discloses an electrode structure utilizing platinum as the catalyst and having various surface loading values such as of 0.4 mg Pt/cm^2 (paragraph 417) and supported active species (platinum electrocatalyst) loading of 0.1 mg/cm^2 and a current density of 150 mA/cm^2 (paragraph 38). Therefore, the electrode provides greater than 150 mA/cm^2 per 100 pg/cm^2 of the area of the carbon nanotubes.

Therefore, at the time of the invention it would have been obvious to one of ordinary skill in the art to use a catalyst metal present in an amount less than 400 $\mu g/cm^2$ and wherein the electrode provides greater than 1 mA/cm^2 per µg Pt/cm^2 of the

planar area of the mat of carbon nanotubes of Smalley et al., because Hampden-Smith et al. teaches that the performance of the electrode is primarily judged by reference to the relationship between the cell potential and the current density (paragraph 279, Figure 10) and it is advantageous to achieve a higher current density at a higher voltage and to maximize cell performance at low platinum loading (paragraph 286). Hampden-Smith et al. also teaches that using the absolute minimum amount of platinum catalyst is necessary for proper cell performance, reduces the cell weight and increases the power density of the fuel cell.

With regard to Claims 8-11, Hampden-Smith et al. discloses an electrode structure utilizing platinum as the catalyst and having various surface loading values such as 0.1 mg Pt/cm^2 (paragraph 417) and 0.05 mg Pt/cm^2 (paragraph 416). Hampden-Smith does not explicitly teach an electrode with a surface loading of 0.025 mg Pt/cm^2 or 0.010 mg Pt/cm^2, however, at the time of the invention it would have been obvious to one having ordinary skill in the art to use the absolute minimum amount of platinum catalyst in the electrode of Smalley et al., because Hampden-Smith et al. teaches this being necessary for proper cell performance and the decrease in the total amount of catalyst required reduces cell weight and increases the power density of the fuel cell. The comparisons discussed in Hampden-Smith et al. evaluate cell performance employing various surface loading values. The comparisons concluded that the cell performance was virtually identical for a cathode loading of 0.1 mg Pt/cm^2 and a catalyst loading of 0.4 mg Pt/cm^2 (paragraphs 415-417). The courts have held

that the determination of optimum values of cause effective variable such as catalyst surface loading values require only ordinary skill in the art. See MPEP 2144.05.

With regard to Claims 12, 13 and 17, Hampden-Smith et al. discloses in one embodiment, a proton exchange membrane fuel cell (PEMFC) utilizing the electrocatalyst electrodes for chemical reactions (paragraphs 0101,0313), and in a second embodiment, Hampden-Smith et al. discloses utilizing a direct methanol fuel cell (DMFC) (paragraph 0314). Therefore, at the time of the invention it would have been obvious to one of ordinary skill in the art to use either a PEMFC or DMFC with the electrode of Smalley et al., because Hampden-Smith et al. teaches that one of the critical requirements for these energy devices is the efficient catalytic conversion of the reactants to electrical energy. A significant obstacle to the wide-scale commercialization of such devices is the need for highly efficient electrocatalyst materials for this conversion process.

With regard to Claims 14-16, Hampden-Smith et al. discloses a membrane electrode assembly (MEA) having a supported active species (platinum electrocatalyst) loading of 0.1 mg/cm^2 and a current density of 150 mA/cm^2 (paragraph 38). Therefore, the electrode provides greater than 150 mA/cm^2 per 100 $\mu g/cm^2$ of the area of the carbon nanotubes. Hampden-Smith discloses that the performance of the MEA is primarily judged by reference to the relationship between the cell potential and the current density (paragraph 279, Figure 10). Therefore, it is advantageous to achieve a higher current density at a higher voltage and to maximize cell performance at low platinum loading (paragraph 286). Although the current density is not explicitly stated as

greater than 10, 50, or 100 mA/cm^2 per μg/cm^2, it would have been obvious to one having ordinary skill in the art at the time of the invention to optimize the performance of the MEA (see Claims 66-70 of Hamden-Smith et al.). It has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. See MPEP 2144.05.

4. The rejection of Claim 4 under 35 U.S.C. 103(a) as being unpatentable over Smalley et al. (US 2005/0249656 A1) and Hampden-Smith et al. (US 2003/0198849 A1), as applied to Claims 1, 6, 8-17 and 63 above, and in further view of Fisher et al (US 6,203,814 B1), is maintained. The rejection is repeated below for convenience.

Smalley et al. and Hampden-Smith et al. disclose the fuel cell electrode in paragraph 3 above, but do not disclose wherein the functional group is a carboxylic acid.

Fisher et al. discloses a method of making functionalized nanotubes wherein the graphitic nanotubes or fullerenes are functionalized by chemical substitution (see abstract). Fisher et al. also discloses the use of a polycarboxylic acid in the process to functionalize the carbon nanotubes (column 7 lines 32-41). Therefore, at the time of the invention, it would have been obvious to one of ordinary skill in the art to use a carboxylic acid to functionalize the electrode of Smalley et al. and Hampden-Smith et al., because Fisher et al. teaches the presence of the carboxylic acid aiding in the linking of nanotubes to form a mat or lattice layout (column 7 lines 32-46).

Response to Arguments

5. Applicant's arguments filed November 6, 2008, have been fully considered but they are not persuasive.

Applicants submit that "Smalley does not teach or suggest a fuel cell electrode".

In response to applicant's argument, the recitation "a fuel cell electrode" has not been given patentable weight because the recitation occurs in the preamble. A preamble is generally not accorded any patentable weight where it merely recites the purpose of a process or the intended use of a structure, and where the body of the claim does not depend on the preamble for completeness but, instead, the process steps or structural limitations are able to stand alone. See *In re Hirao*, 535 F.2d 67, 190 USPQ 15 (CCPA 1976) and *Kropa v. Robie*, 187 F.2d 150, 152, 88 USPQ 478, 481 (CCPA 1951).

Applicants submit that, "even if the teachings of Smalley and Hampden-Smith were combined, the combination would not achieve all the limitations of Claim 1, particularly the combination of carbon nanotubes with carbon black or carbon powder. None of the mentions of carbon black in Smalley or in Hampden-Smith relates to or suggests a combination of single-wall carbon nanotubes with carbon black or carbon powder in a fuel cell electrode".

Smalley discloses forming a patterned array of single walled carbon nanotubes in conjunction with carbon black (paragraph 0059), which reads on the claim limitations. Smalley discloses that this combination is used in tires for motor vehicles, but, as noted before, the recitation "a fuel cell electrode" has not been given patentable weight

because the recitation occurs in the preamble. The combination of Smalley and Hampden-Smith is renders the claim obvious.

Conclusion

6. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Karie O'Neill whose telephone number is (571)272-8614. The examiner can normally be reached on Monday through Friday from 8am to 5pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Patrick Ryan can be reached on (571) 272-1292. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Mark Ruthkosky/
Primary Examiner, Art Unit 1795

Karie O'Neill
Examiner
Art Unit 1795

KAO